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latter two preliminary proofs) and South H-34, without being invidious, will readily show this. The representation of all isobaths at an interval of 100 meters compares favorably with their absence below 200 meters on sheets North K-35 and O-29, as does the maintenance of the 100 meter interval for contours up to 600 meters with the use of the 200 meter interval on sheets North O-29, O-30 and K-35. The technical reproduction, too, is worthy of high praise. In delicacy of execution it may well be considered the best among the sheets hitherto issued.

The publication of the first sheet of the map of the United States as a part of the International Map of the World will thus be seen to be a cause for congratulation on the part of the geographic world. Its completion within reasonable time and the maintenance of the standards set by its founders are insured by the high efficiency of the Geological Survey.

THE ORIGIN OF THE HIMALAYA MOUNTAINS*

The value of this paper lies in its application of mathematical analysis to the investigation of features of the earth's surface. The facts adduced from a consideration of the geodetic evidence applied to the genesis of the Himalayan uplift may, in the main, be summed up in the hypothetical existence of a sub-crustal rift that is possibly in the course of present widening towards the north.

The following are phenomena of observation:

1. A rock trough filled with alluvium traverses northern India.
2. The edges of the trough are parallel.
3. A line of deficient density, presumably in the sub-crust, is found to traverse the whole trough.
4. The earth's surface north of the trough is heavily wrinkled.
5. The surface of the trough is not wrinkled.
6. The mountain wrinkles north of the trough are compensated by deficiencies of density beneath them (but these deficiencies are not comparable in degree with the deficiency underlying the line just south of the base of the mountains).
7. The trends of the main granite ranges of the Himalayas, Karakoram, and Hindu Kush, as well as of the minor ranges, are parallel to the line of low density and to the edges of the alluvial belt.
8. The mountain folds north of the trough are overthrust towards the south.

The Indo-Gangetic alluvial belt is well defined. It separates the tertiary formations lying to the north from the pre-tertiary table-land forming the Indian peninsula. The parallelism of its edges constitutes a feature of particular interest. This is revealed on the map by the trend of the Himalayan, Hindu

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*On the Origin of the Himalaya Mountains. A Consideration of the Geodetic Evidence, by Colonel S. G. Burrard. 26 pp. Map. *Prof. Paper* No. 12, Survey of India, Calcutta, 1912.

Kush* Sulaiman and Kirthar ranges on the one hand and the similarly irregular course of the border line skirting the foot of the northerly outliers of the pre-tertiary continental relics. The recurrence of the same phenomenon farther west on the opposite shores of the Gulf of Oman and the Persian Gulf is even more remarkable. All southeastern Arabia can be geologically correlated to the Indian peninsula. The whole chain of mountains that rises on the border of Kurdistan and of Persia is a Tertiary uplift. So is the southerly extension of this chain in Beluchistan. The intervening sea corresponds to the Indo-Gangetic alluvial belt. The parallelism is well marked at Bendar Abbas and Cape Massandom. It does not appear to end at this region, however. Another alluvial belt extending almost to the Mediterranean forms the basin of the Euphrates and the Tigris. This basin is the zone of separation between the tertiary uplifts that converge in three great arcs at Mount Ararat and the pre-tertiary Arabian land mass. Each of these belts can furthermore be considered as links in a probable belt of fracture that encircles the globe, and a section of which extends uninterruptedly from the straits of Gibraltar through the Mediterranean, the Mesopotamian valley, the Persian Gulf, the Indian Ocean, the Indo-Gangetic alluvial plains and the Arrakan coast down to Sumatra.

The results of plumb-line observations in the Indo-Gangetic plains may be summarized as follows: the deflections of the plumb-line show most extraordinary variations all along the foot of the Himalayas. Between Kurseong and Jalpaiguri, in the Eastern Himalaya, for example, the deflection changes 45″ in 25 miles. This variation calculated from the uncompensated topographic features should be 25″. On Hayford's hypothesis of isostasy it should be 15″.

Again between Birond and Nimkar in the Central Himalayas the deflection of gravity changes 43″ at the foot of the mountains. This variation as deduced from topographic features and uncompensated is 31″. On Hayford's hypothesis of isostasy it is 13″.

Passing to the western Himalayas, it is found that the change in deflection between Dehra Dún and Kaliana is 30″ as observed. That deduced from topographic features is 29″, while the variation calculated on the Hayfordian hypothesis is 15″. The Himalayan foot is therefore characterized by the existence of a long line in which the change in deflection is actually much larger than it would be if the whole uplift were exercising its entire attraction uncompensated.

In discussing the meaning of the line of low density it is assumed that the Himalayas are isostatically compensated in accordance with Hayford's hypothesis. Considering the data from the typical stations of Kurseong and Jalpaiguri it is found that throughout 2,000 miles in length round the foot of the Himalayan mountains we have an unexplained change in deflection of 30″ in 25 miles.

The extraordinary rift in the deflections all along the foot of the Himalayas renders the consideration of Himalayan compensation very difficult. The effects of the rift are so great that they obliterate the effects of topography and isostasy.

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* The trend of the Hindu Kush Range mapped on Pl. II. of Colonel Burrard's paper does not coincide with its ordinary representation. It is usually shown as rectilinear instead of convex to the north as in this instance. It is assumed, of course, that the strike thus mapped is based on the work of the Indian Survey and that it hence merits preferably universal adoption. The argument, however, does not rest on the matter of the southerly concavity of any of these four main ranges. It rests on the parallelism of the edges of the alluvial belt. Thus viewed the constancy of this parallelism is unmpaired by the locus of the Hindu Kush represented on the above mentioned plate.

In the alluvial plains of northern India, the observed deflections are in opposition to both the topography and to the theory of isostasy. We have here:

Mean observed deflection....................................	5″ south.
Mean topographic deflection..................................	10″ north.
Mean Hayfordian deflection on the hypothesis of isostasy.....	1″ north.

The southerly deflections prevailing throughout the northern portion of the Peninsula cannot be accounted for by the hypothesis of isostasy nor can they be attributed to the topography. In the central portion, on the other hand, northerly deflections are met with which are less at variance with the results due to the topography.

The value of Colonel Burrard's work will be enhanced by a comparison of the relation between its results and the geology of the regions investigated. The subject of gravity anomalies in the United States has been investigated by Bowie* who found that, while they appear to be very small, they are related to the surface geologic formation. The study of the origin of any mountain chain, however, is necessarily subordinate to the collation of data afforded by all branches of human knowledge. Evidence based on results obtained along a determined line of observation is necessarily incomplete and must be supported by information derived from what may often appear to be a remote source. In the present instance, the mathematical factor introduced by geodetic computations may be said to impart weightier consideration than the tenor of the Suessian views which are based chiefly on tectonics and wherein the accumulated details refer to the larger features of the problem. A study of the physiography of the Himalayas would also probably throw further light on the genesis of the uplift. Particularly so if applied to the consideration of contemporary mountain-making agencies. More knowledge on the line of deficient density might also be obtained by geodetic observations at other points of the belt of fracture encircling the globe, especially in the northern West Indies and the Isthmus of Tehuantepec.

LEON DOMINIAN.

EMIL VON SYDOW AND THE DEVELOPMENT OF GERMAN SCHOOL CARTOGRAPHY

In the *Geographischer Anzeiger* for September, in connection with the centenary of his birth, an interesting summary is given of Emil von Sydow's influence on the development of school cartography in Germany. Born in 1812, he was trained for the army and received his officer's patent in 1830. During his studies he devoted himself especially to the geographical side of military science. This led to his appointment, three years later, as instructor of geography at the institution where he had received his training, the Military Academy at Erfurt. This position he occupied from 1833 to 1843.

He felt keenly the lack of adequate material for teaching geography, especially the lack of good wall maps. Unexpected success in the preparation of such maps in his spare hours encouraged him to approach Justus Perthes in

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* "Some Relations between Gravity Anomalies and the Geologic Formation in the United States," by W. Bowie. *Amer. Jour. of Sci.*, March, 1912, pp. 237-240.